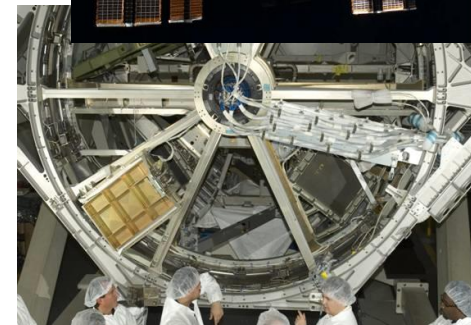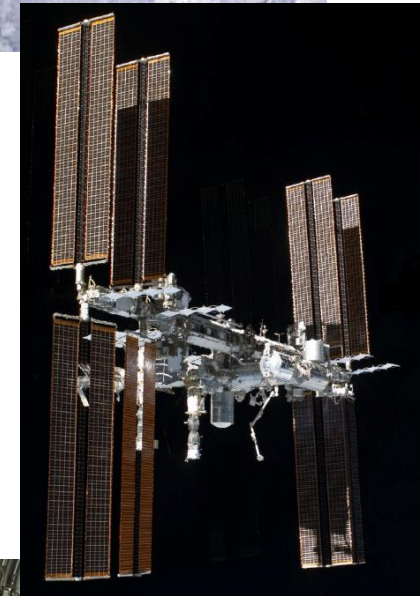# Structural Monitoring to Minimize Inspections

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NASA/Johnson Space Center

NASA In Space Inspection Workshop (ISIW) 2014
15-16 July 2014
NASA Johnson Space Center, Houston TX

◆ **ISS structures were certified for a 15-year life.**

◆ **Zarya launched November 1998, over 15 years ago.**

◆ **Structural life extension analysis has been performed to certify that ISS structures are good through 2020 and beyond.**

- Analysis has taken into account load cycles calculated from actual events vs the cycles assumed during design.

- Re-constructing actual load cycles is performed using telemetry and data from the ISS.

- Data/Sensor systems have been invaluable to allow proper loads reconstructions, especially for unexpected high-loading events.

- Data/Sensor systems have been utilized to provide trending information for rotating joints, allowing for longer inspection/lube intervals.

◆ **Future space vehicles should incorporate smarter, smaller, and power efficient sensor systems:**

- Monitor structural dynamics and rotating joints, perform on-board processing, alert crew real-time to any high loading events, store only the data ground needs to evaluate structure.

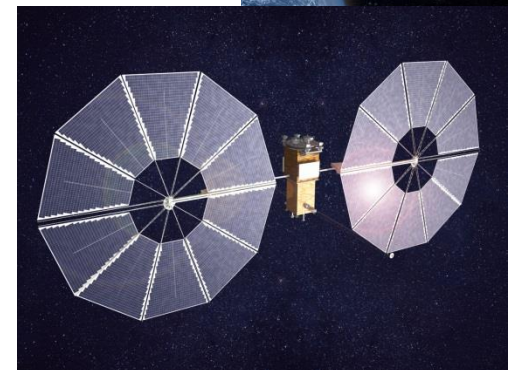◆ **MMOD shielding is designed into the ISS pressurized modules, but not for the truss and appendages.**

- US Photo-Voltaic (USPV) masts are designed to be 2-fault tolerant, but inspections need to be performed to verify the 1st fault hasn't occurred.
- Current inspection requires crew time to take detailed photographs of mast on a periodic basis.

◆ **ISS USPV MMOD impact monitoring**

- Need a system that could be deployed robotically or via EVA that could monitor for MMOD impacts.
- This could trigger a detailed inspection.

◆ **Future vehicles could incorporate this type of system in the design of the solar array support structure itself.**
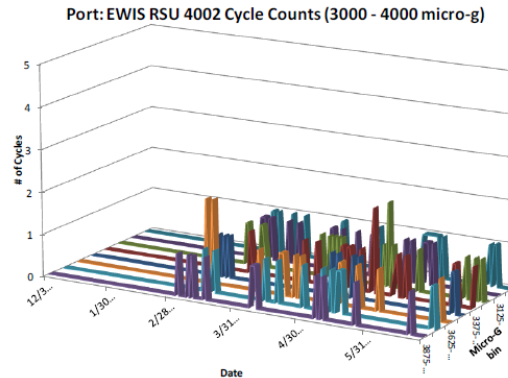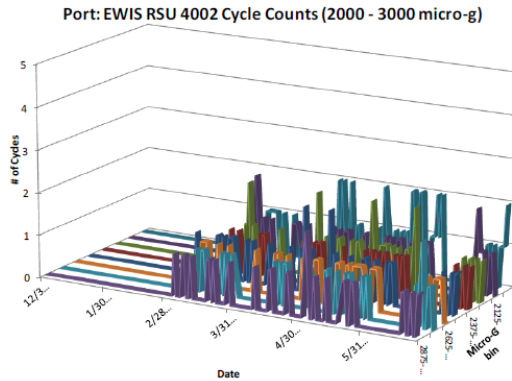
- This could trigger a detailed inspection.
- Monitor dynamic strain and accelerations to assess loading history and alert crew if arrays are experiencing high loads.
- Monitor for MMOD impacts.
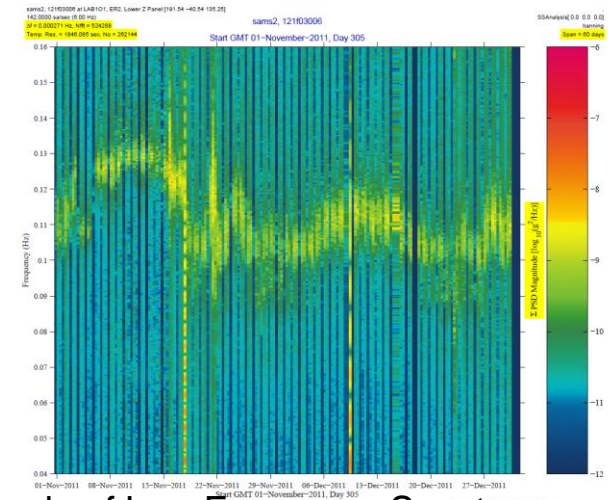- Structural health monitoring system would also include a means of locating and assessing damage.

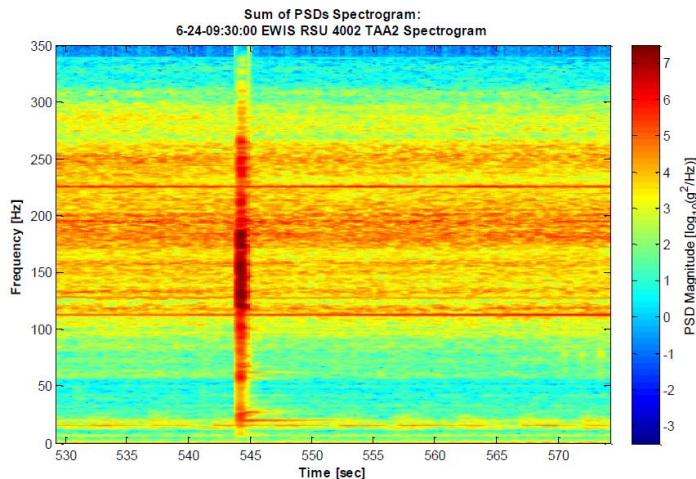## Break in EWIS PORT 4002 High Transients from GMT 146-165 (5/26-6/14)

PORT

Port: EWIS RSU 4002 Cycle Counts (2000 - 3000 micro-g)

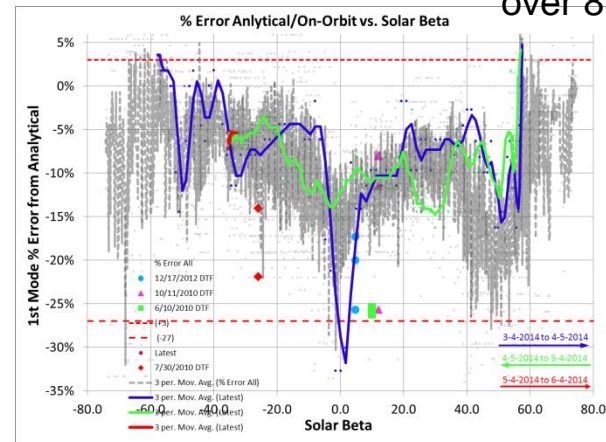Port: EWIS RSU 4002 Cycle Counts (3000 - 4000 micro-g)

Sample of Cycle Count Data over Months

Sample of Low Frequency Spectrogram over 8 Hours

Sample of High Frequency Spectrogram over 10's of seconds

1st Global Mode Frequency tracked over Months (filtered .05-.15 Hz, largest amplitude per 39 second psd)